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THE NATURAL METHOD OF VOICE PRODUCTION

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A complete investigation of voice production involves two steps: first, a study of the voice itself, or the various combinations of air-waves which affect the auditory mechanism of the listener; and, secondly, an inquiry into the action of the mechanism which produces the voice. The first part of this investigation lies in the field of physics; the second, in the province of anatomy and physiology. From 1879 to 1893 the present writer made a careful and continuous study of the anatomy and physiology of the voice mechanism in its relation to voice production. After about ten years of this time had elapsed, interspersed with periods of study with some of the leading voice teachers of this country, the writer became convinced that the problem of correct voice production could not be solved by a consideration of anatomy and physiology alone. Then began a course of reading on the physics of sound production, which resulted in the conclusion that nothing but an analysis of the voice itself could definitely determine the correct action of the voice mechanism. This was the problem which the author brought to the late Professor William Hallock, professor of physics at Columbia University, on January 1, 1893. We immediately began what we agreed should be a strictly impartial scientific investigation of the action of the voice mechanism from the standpoint of anatomy (structure of the mechanism), physiology (function of the various

parts of this mechanism), and physics (laws which regulate its action).

After perfecting the apparatus for voice analysis, we photographed thousands of voices, ranging from those of such caliber as Jean and Edouard de Reszke's, Nordica's, Scalchi's, Calvé's, and others of equal prominence, to voices of the veriest tyros in the field of voice production.

We then studied, so far as possible, the structure and action of the mechanisms which produced these various voices. Many interesting and valuable discoveries resulted from this study. Among the most important of these was the fact that the voice mechanism is a stringed instrument, which was contrary to the statements of all writers up to that time, including such prominent physicists as Helmholtz, König, Tyndall, and others.

Having established this fact, we reasoned that the vocal apparatus must include a mechanism for changing the length, weight, and tension of the vibrator (vocal cords) similar to that found in other stringed instruments. This led to a discovery of the correct action of the "vocal muscle" (thyro-arytenoideus) and the crico-thyroid muscle in pitch changes.

As these studies progressed, the impression that resonance is the determining factor in both volume and quality forced itself upon us. We began to investigate the question of resonance as applied to the voice mechanism. Our most important discovery was made in this field. We found that the raising of the soft palate shut off the cavities of the upper pharynx and nose and thus diminished by more than one-half the resonance capabilities of the voice mechanism. This action of the soft palate resulted in the loss of more than one-half of the voice itself, as shown by our photographic analysis.

After having trained some singers to produce the voice with the low position of the soft palate, we found that the resulting tone was not altogether satisfactory. This led to a further investigation of the mechanism and the discovery of false cord and tongue interference.

Finally it was found that all of these interferences hampered the action of the pitch mechanism, so as to cause a loss of two

factors in pitch changes, viz., the variation in the length and in the weight of the vocal cords.

In summing up the whole matter of interference, we found that there was not only an appalling loss in volume, quality, and range of pitch of the voice, but that the use of the mechanism under these conditions resulted in a deterioration of the vocal instrument, so that effective singing and speaking became impossible. The percentage of voice students who can withstand a long period of training under the present systems and who eventually appear before the public is very small as compared with those who go into the work. Most of these failures are due to the breaking down of the voice mechanism through interference. Those singers whose vocal muscles are strong enough to withstand the abuse of a course of training with interference and who finally make their appearance in public do not last as long as they should. The vocal muscles, if not injured and weakened by interference, will last as long as any other muscle. We should be able to sing and speak effectively as long as we can walk. Conditions today, however, may be expressed in the words of a famous singer: "Twenty years ago, when I had a voice, I had no reputation. Now I have a reputation, but I have no voice."

The next step, which devolved entirely upon the writer, was the evolution of a method and the formulation of a series of exercises which, *if properly performed*, will remove these interferences and give full development of the voice mechanism. This method applies with equal force to the speaking and the singing voice, as the correct action of the mechanism in both is precisely similar.

An important factor in the evolution of this method was a consideration of the nature of the two sets of muscles involved, namely, the true tone-producing muscles and the interfering muscles. We found that the action of the tone-producing muscles is involuntary, while that of the interfering muscles is voluntary. This is the fundamental fact underlying the natural method of voice production. It is the great stumbling-block in the path of every teacher and student. Every method now in vogue ignores this most important fact underlying the training of the voice mechanism.

At the very outset the pupil who sings or speaks for the teacher feels that he is doing something out of the ordinary and naturally

tries to do the best he can. The fact that he tries involves a use of the will, which brings into action the voluntary or interfering muscles. This effort on the part of the pupil is seldom satisfactory to the teacher. The latter then directs the pupil, either by example or otherwise, to sing the tone in some other manner, establishing still further this voluntary action or interference. The case thus becomes hopeless from the start. If the teacher had realized the nature of these two sets of muscles, his method of procedure would have been the opposite of this.

The foregoing shows why imitation of great artists is not desirable. In the first place, any imitation of the voices of great artists is impossible; any attempts to imitate a tone, to exert a voluntary control over the vocal muscles, means interference. In the second place, many of our great artists have very faulty voice production.

It has been the experience of men in all ages that attempts to accomplish an object by working against nature are not only futile but result in disaster. On the other hand, the successful man first investigates the character of an undertaking and then directs all his efforts in accordance therewith. The more thorough his investigation the more successful his results.

This rule applies to all lines of business, including that of voice production. If we would be successful in our treatment of the vocal mechanism, we must follow the course pointed out by its nature. It is the business of the anatomist to know the structure of the voice mechanism, of the physiologist to know the function of this structure, and of the physicist to know the laws of mechanics which regulate the action of this structure in such a manner as to give full use of its function. Herein lies the *nature* of the business of voice production. Only where all of the functions of the vocal structures are brought into use, by the correct application of the laws of mechanics, are we working in accord with the nature of the vocal instrument.

There is an impression, which is very prevalent among voice teachers and students, that any knowledge of the anatomy and physiology of the voice mechanism is not only useless but detrimental to both. There is a very good reason for this impression, although it is a wrong one. The fault lies largely with the anato-

mist and the physiologist. The latter has told the voice student and the teacher that there is a mechanism. What more natural than that they should try to do something with it? The anatomist and the physiologist should have gone a step farther and explained fully the *nature* of this mechanism. The teacher and the student would then have appreciated the futility of any attempt *to do anything* by direct conscious effort with the voice mechanism.

The laws which regulate voice production are precisely the same for every singer and speaker, and every mechanism which produces the voice is exactly similar. Every voice mechanism has vocal cords of exactly the same material—yellow elastic tissue; the action of the cartilages and muscles of the larynx is precisely the same in every speaker and singer, and the conditions which give full use of the resonance space are identical in every normal voice mechanism. Differences in the length and weight of the vocal cords and in the size and shape of the resonance cavities account for differences in the natural quality of voices. For the foregoing reasons there can be one and only one standard method for the teaching of voice production. This must be in accord with the nature of the mechanism and hence may be termed the natural method of voice production.

Correct voice production consists in the free vibration of the vocal cords, the free motion of the cartilages and muscles of the larynx, and the full use of the resonance space. Anything which prevents any one of these actions is termed an interference. Every form of interference leaves its blemish on the natural volume and quality of the tone. Hence it is possible to train the ear to hear in the quality of the tone the interference with the normal action of the mechanism. Tone quality is, therefore, a test for normal action.

The competent vocal teacher is one, first, who understands the nature of the voice mechanism, secondly, who can detect in the tone quality of the pupil's voice the interference with the correct action of the mechanism, and, thirdly, who can teach him how to eliminate interference and how to develop the vocal muscles.

In the hands of a competent vocal teacher the student should learn within a year how to diagnose and eliminate interference and

how to develop his vocal muscles. After he has learned to do this the voice services of the teacher of voice production are no longer necessary. Full development of the voice, however, would require from three to five years' work on the part of the student, depending upon the extent of injury to his vocal muscles in the beginning. Finished speech and song involve two things—correct voice production and interpretation. Without correct voice production our speech and song degenerate into mere mummery and disagreeable sounds. This effect often becomes distressing or ludicrous to the listener on account of evident bodily strain or facial contortion. With correct voice production the matter of interpretation becomes comparatively simple. The latter depends upon the knowledge and experience of the singer or, in other words, upon his mental capacity. The nature of the voice mechanism itself and the nature of the art of singing both demand that, once the correct action of the mechanism is established, the singer or speaker should give no thought to the production of his tones. The voice mechanism was made involuntary so that the whole mind of the performer could be centered upon interpretation. This article deals with voice production and not with interpretation.

The author has frequently been taken to task because he disagrees with all the so-called "authorities" on voice production. The question arises, Who is an authority on voice production? As we have already stated, the science of voice production is based upon the sciences of anatomy, physiology, and acoustics. It will be found upon examination that the author is in full agreement with the anatomist, the physiologist, and the physicist, and, therefore, the foregoing statement is untrue. The authors of the current books have not been familiar with the anatomy, physiology, and physics of voice production, and therefore are not authorities. There is nothing mysterious or secret about the teaching of voice production. There is no reason why any one teacher of voice production should possess knowledge which cannot be acquired by every other.

As the voice is a complex tone, a complete description of it requires an analysis or a separation of the voice into its partial tones. The apparatus employed for the analysis of tone is prac-

tically that devised and used by König and Helmholtz, but with some essential modifications. It depends upon resonance; that is, upon the fact that a hollow sphere with a circular opening, about one-fourth to one-sixth the diameter of the hollow sphere, will reinforce one pitch and one only. Its air can normally vibrate at that rate, and at no other. The pitch of the tone which such a "resonator" will pick out depends upon the diameter of the sphere and that of the opening. Fig. 1 shows a section of such a resonator, as made by König. *B* is the opening with a slight lip, with which it is tuned. *C* is a slight conical extension at the back, opposite to *B*. If this extension is put into the ear it will be found that all sounds are heard faintly, except those of the pitch to which the resonator is tuned, and this is greatly reinforced. With sets of such resonators one is in a position to determine, by listening, whether a given tone is present in any complex sound. This method is very accurate and delicate, but very inconvenient. König devised a better way of observing what the resonators are doing. We have, however, decidedly modified König's apparatus. The resonators *A* (Fig. 1) are so mounted in a plank *P* that the point *C* is flush with the back. A block *H*, screwed upon the back of *P*, has a conical hole

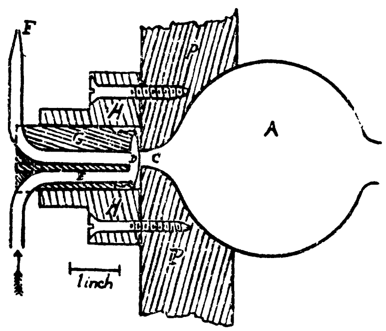

FIG. 1.—Section of resonator and its manometric capsule. *A*, Resonator. *B*, Mouth of resonator where air-waves enter. *C*, Small extension through which the air-waves strike upon the rubber drum between *D* and *C*. *D*, Space behind the drum to which the gas enters through the tube *E*, and from which the gas passes out and burns at *F*. *G*, Wooden plug carrying gas tubes and hollowed out to form the space *D*. The rubber is stretched and tied over the end of *G*. *H*, Block to hold *G*. *P*, Plank on which the whole is mounted.

conaxial with the resonators, into which fits the conical plug *G*. The inner end of *G* is hollowed out to leave a small cavity *D*, over which a thin membrane of rubber is stretched. The latter is bound around the end of *G*. Gas enters the cavity *D* by the tube *E*, escaping by the central tube, and burning in the small flame at *F*. When the tone

of this resonator is sounded, the air in A responds (that is, it vibrates), making the drum-head at D vibrate, thus causing the little flame at F to jump at the same rate as the vibrations of the tone. Looking simply at the flame we see little change, since its jumps are so rapid, 128 to 1,024 per second, that the eye fails to distinguish them. If, however, we observe the flame in a moving mirror, each jump will appear in a different place, and hence be visible. A stationary flame viewed in such a rotating mirror appears as a line of light; a jumping flame appears like the teeth of a saw, the distance between the teeth depending upon the relation of the rapidity of motion of the flame to that of the mirror. Similarly, if the image of such a flame fall upon a moving photographic plate, the trace developed will be a true report as to the state of rest or agitation of the flame. Fig. 2 is such a record when a certain voice was singing *ä* (as in "father") upon the pitch of our standard fork, which is 128 vibrations per second, or about "bass C." The number of vibrations that the fundamental or characteristic tone or pitch of a string bears to the rate of its overtones, harmonics, or upper partials, is the ratio of 1 to 2, 3, 4, 5, 6, etc. Hence our resonators are tuned to bass C and its first seven overtones, whose rates of vibrations and approximate pitches are given below:

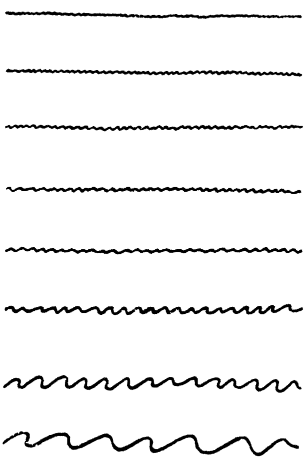

FIG. 2.—Photograph of the motion of the flames while singing the vowel *ä* as in father. The lower line is the fundamental, and the others are the 1st, 2d, 3d, etc., overtones in the order of their pitch. One wave of the fundamental corresponds to two in the first overtone, three in the second, four in the third and so on.

Fundamental, 128 vibrations per second, about bass C.
1st overtone, 256 vibrations per second, about middle C.
2d overtone, 384 vibrations per second, about middle G.
3d overtone, 512 vibrations per second, about treble C.
4th overtone, 640 vibrations per second, about treble E.
5th overtone, 768 vibrations per second, about treble G.
6th overtone, 896 vibrations per second, about treble B^b.
7th overtone, 1,024 vibrations per second, about high C.

Soft-palate interference consists in the raising of the soft palate against the back of the pharynx, thus shutting off the air-waves from the upper pharynx and nasal cavities. The effect of this one form of interference upon volume and quality can readily be appreciated by a consideration of Figs. 3 and 4. Fig. 3 shows the action of the mechanism without soft-palate interference and the resulting

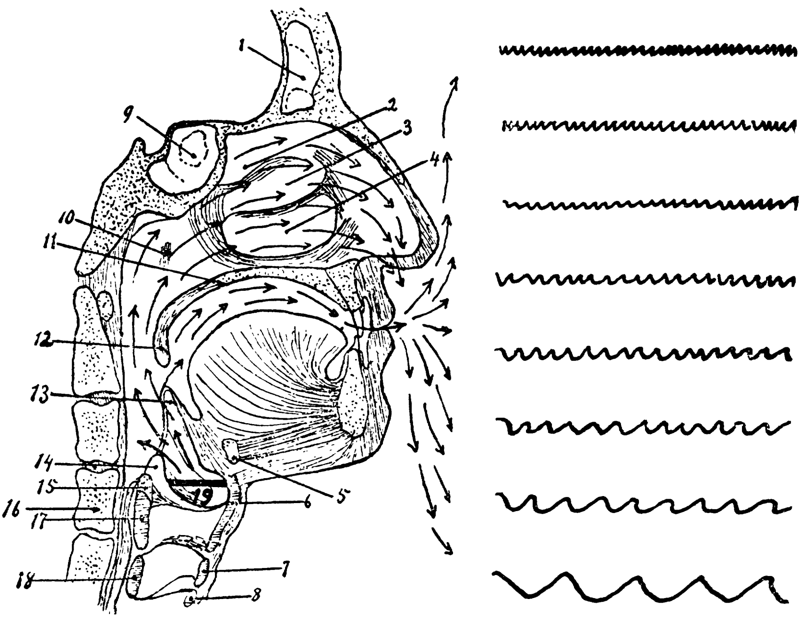

FIG. 3.—Vertical section of the head to show location and relative size of the resonance cavities. 1.—Frontal sinus. 2, 3, and 4.—Turbinated bones. 5.—Hyoid bone. 6.—Thyroid cartilage. 17.—Cricoid cartilage. 7 and 18.—Top ring of the trachea. 9.—Sphenoidal sinus. 10.—Epipharynx. 11.—Hard palate. 12.—Soft palate. 13.—Epiglottis. 14.—Arytenoid cartilage. 15.—Arytenoideus muscle. 16.—Vertebra. 19.—Vocal cords.

combination of partial tones. Fig. 4 shows the contraction of the soft palate while the same singer is singing the same vowel and the resultant combination of partial tones.

In Fig. 3 there is full use of the resonance space, and the resulting tone has eight partial tones, with the fundamental very strong and the overtones decreasing in strength as they rise in pitch. In Fig. 4 the upper pharynx and nasal cavities are shut off, with the result that the four highest overtones are "damped out." The

fundamental tone is weakest and the overtones increase in strength as they rise in pitch. These analyses are not guesswork but actual measurements of the voice produced by the same singer without and with soft-palate interference. According to these records, this one form of interference takes away one-half the volume of the voice and further deprives the singer of a richness of tone which is his natural gift and is his if he will simply relax these muscles of the soft palate.

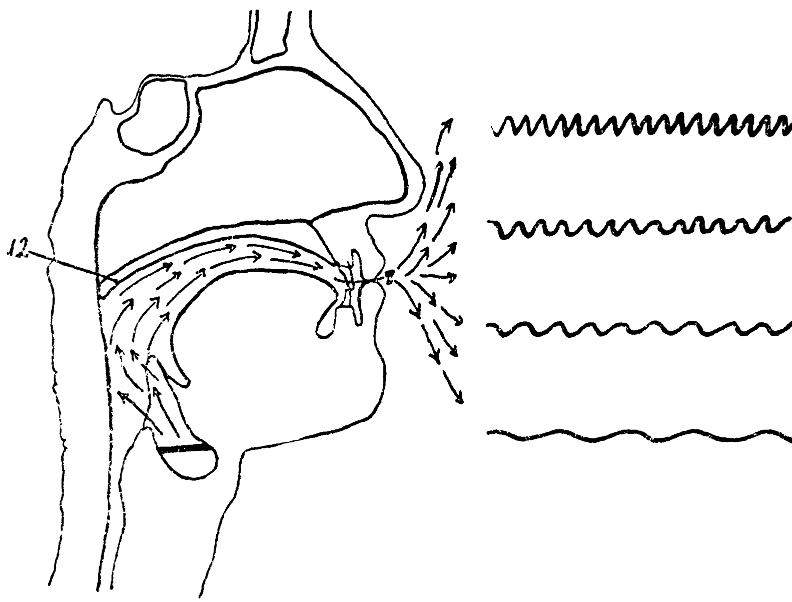

FIG. 4.—Vertical section of the head—similar to Fig. 3—but showing how the raising of the soft palate (12) and closing of the passage diminishes the space available for resonant reinforcement, by cutting off the large cavity of the upper pharynx and nose.

The following voice photographs were made during the course of this investigation. Fig. 5 is a photograph of Jean de Reszke's *ä*. This analysis is typical of soft-palate interference with only moderate false-cord interference. The overtones above the third are absent, while the relative intensities of the partial tones are not in their most favorable combination for the best tone quality, the second and third overtones being stronger than the fundamental.

Edouard de Reszke's *ä*, as shown in Fig. 6, is not as favorable a combination of partial tones as in Fig. 5, since the overtones are even stronger in comparison with the fundamental tone. The weak fundamental and the loss of the four highest overtones show soft-palate interference, while the strong second and third overtones denote decided false-cord interference.

In Fig. 7 Nordica's *ä* shows a comparatively strong fundamental. This photograph shows lack of nasal resonance, but little false-cord interference.

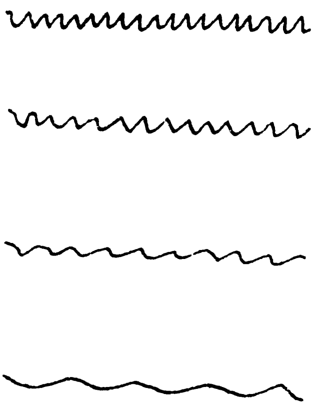

FIG. 5.—Jean de Rezké's *ä*

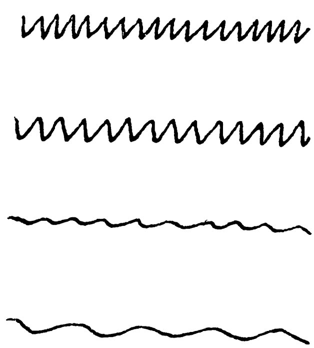

FIG. 6.—Edouard de Rezké's *ä*

Calvé's *ä*, in Fig. 8, shows a weak fundamental with a very strong second overtone. This denotes lack of nasal resonance and strong false-cord interference.

Photographic analyses of thousands of voice tones demonstrated that the strong fundamental was absolutely essential to good volume and good quality. We can, therefore, realize that the student should have a clear conception of what the strong fundamental tone sounds like. A tone produced by a tuning fork and its resonator is a pure fundamental tone. A very clear idea of the desired quality of the voice may be gained from listening to such a tone. As an appreciation of the proper quality is so necessary, particularly in the beginning of voice development, it is very essential that every teacher, and, if possible, every student should possess

such a tuning fork and resonator. An idea of the proper beginning of a tone may be learned by allowing the vibrated fork to approach the opening of its resonator slowly.

The first thing to be accomplished in the natural method is the production of tone without disturbing the position of rest of the extrinsic or interfering muscles. This may be done most easily by producing soft tones with the mouth closed.

Great care should be exercised as to how the tone begins. There are three things to notice about the beginning of a tone. First, the voice must begin absolutely on the pitch. Any sliding up to pitch means false-cord interference. Secondly, there should be no "jerk" at the beginning of the tone. This—which is sometimes called the

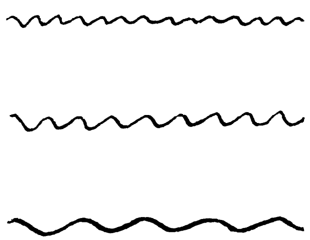

FIG. 7.—Nordica's ä

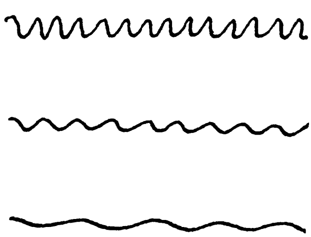

FIG. 8.—Calvé's ä

"stroke of the glottis"—also indicates false-cord interference. Thirdly, the tone should be entirely free from the so-called "nasal" or "metallic" quality, which likewise means interference of the false cords. If difficulty is experienced in producing tone without interference, the pupil should be directed to diminish his tone continually until the interference disappears. As voice quality may perhaps be better studied in the sustained tone, it may be advisable in the beginning to sustain the hum and to note carefully the presence or absence of this "nasal" quality. In a properly produced soft hum the tone is practically all fundamental. The overtones are so weak that they have very little influence on the quality. As soon as the proper tone quality is recognized by the student, the tone should be shortened as much as possible, still maintaining the right beginning and the right quality.

The principles of muscular development point out that the ideal exercise for developing the vocal muscles—the only element of the

voice mechanism which can be developed—consists in the production of short, soft tones without interference. It is impossible in the beginning of voice development to sing loud or sustained tones without interference. Such tones overwork the vocal muscles, and in time will injure and weaken them. Practice on such tones is entirely contrary to the first principles of muscular development.

As pronunciation of words includes the use of both vowels and consonants, it is desirable to first combine the consonants with the vowel *ē*.

The object of any exercise for voice development is twofold, first, to break up the association between the articulating and the extrinsic or interfering muscles, and, secondly, to develop the intrinsic or true tone-producing muscles. Soft palate interference is necessarily brought in by the production of certain consonants, such as the *t* and *k*. But this interference should be immediately dropped upon the beginning of the tone.

The consonants *m*, *p*, and *b* require the closing of the lips and the shutting off of that part of the tone which is coming through the mouth, so that only the tone which passes behind the soft palate and through the upper pharynx and nasal cavities can be heard. For this reason a combination of the consonant *m* and the vowel *ē* forms an excellent exercise for establishing the low position of the soft palate. As *m* requires the closing of the mouth, it cannot be articulated unless the soft palate is down, thus allowing the tone to come out through the nose. If we repeat *m* rapidly enough the soft palate has not time to go up between times and hence remains down. The *mē-mē-mē* exercise, which is merely the hum with the motion of the lips added, will, therefore, establish the low position of the soft palate. The greatest care must be taken in this exercise to keep out the so-called "nasal" quality, which signifies false-cord interference and which is so often associated with this exercise. The quality of the tone should frequently be compared with that produced by the tuning fork and resonator. This latter quality should at all times be heard strongly in every voice tone.

All the consonants may be thus combined with the vowel *ē*, as *tē-tē-tē*, *lē-lē-lē*, *gē-gē-gē*, etc. The use of these exercises, if done without interference, will break up the association of the actions

of the articulating and extrinsic muscles and will aid in the development of the vocal muscles.

As many words begin with vowels, it becomes necessary to establish the correct action of the voice mechanism for the vowel sounds without a preceding consonant. As ē disturbs least the position of rest of the extrinsic muscles, it is found desirable in most cases to begin with this vowel. If difficulty is experienced in producing ē with nasal resonance, this exercise may be begun with the *mē-mē-mē* and finished by sustaining the vowel ē alone.

As with ē, the other vowel sounds may be combined with *m* to insure the use of nasal resonance and then sustained alone, as *mā-mā-mā-ā*, *mō-mō-mō-ō*, etc. The different consonants may then be combined with the various vowel sounds, as *mē-mā-mä*, *lē-lā-lä*, *gē-gā-gä*, etc.

There is one pitch in every voice where it is easiest for the pupil to get good tone quality. The exercises should all be practiced in the beginning on this pitch. The pupil can then gradually work up and down from this pitch, limiting the practice, however, to those tones without interference.

This is a brief description of some of the most important exercises for voice development. A complete description of the natural method of voice production cannot be given in an article of this scope.

The exercises described above, *if properly performed*, will give an unhampered action of the vocal cords and full use of the resonance space. The method thus outlined conforms both to the natural law of voice production and to the nature of the mechanism. It may, therefore, be rightfully termed the natural method of voice production.